NOAA Scientific Publications Report
June 22 – July 13, 2012

Contents

1. HIGHLIGHTED ARTICLES

1a. Title: Low-level copper exposures increase visibility and vulnerability of juvenile coho salmon to cutthroat trout predators
Journal: Ecological Applications
Authors: Jenifer K. McIntyre, **David H. Baldwin (Northwest Fisheries Science Center)**, David A. Beauchamp, and **Nathaniel L. Scholz (Northwest Fisheries Science Center)**
Publication Date: 2012

Summary: Pacific salmon rely on olfaction for a variety of critical life history processes that include imprinting and homing, predator detection and avoidance, and reproductive maturation. Previous studies have shown that copper is highly toxic to the salmon olfactory system. Copper contamination in surface waters is common in watersheds with mining activities or agricultural, industrial, commercial, and residential human land uses. Among Pacific salmonids (Oncorhynchus spp.), copper-induced olfactory impairment has previously been shown to disrupt behaviors including predator avoidance behaviors triggered by a chemical alarm cue, but the survival consequences of this disruption have not been explored. In this study, juvenile coho were exposed to low levels of dissolved copper (5–20 lg/L for 3 h) and then presented with cues signaling the proximity of a predator. Unexposed coho showed a sharp reduction in swimming activity in response to predator cues from cutthroat trout, while this alarm response was absent in prey fish that were exposed to copper. Additionally, in predation trials, cutthroat trout were more effective predators on copper-exposed juvenile coho. This study concludes that olfactory disruption leads to reductions in individual survival due to increased rates of predation mortality.

Important conclusions:

- When exposed to copper on a timescale of minutes, juvenile salmon lose their sense of smell and fail to respond to chemical cues in their environment making them unprepared to evade nearby predators and significantly less likely to survive an attack.
- These findings contribute to a growing understanding of how common environmental contaminants alter the chemical ecology of aquatic communities.

Degree of Controversy: High. Likely to be high, due in part to relevance to the proposed Pebble Mine in Alaska. Media interest in NWFSC research on copper in recent years has been relatively high. This includes, for example, a forthcoming installment of Frontline. Political interest has also been high; for example, past salmon studies by NWFSC were influential in terms of California and Washington passing new legislation to phase out metals, including copper, in motor vehicle brake pads.

Press release/Roll out plan: WSU is developing a press release.

2. ADDITIONAL ARTICLES

Top Tier Journals
None.

Intermediate-Tier Journals

2a. **Title: Common patterns, common drivers: comparative analysis of aggregate surplus production across ecosystems**
Journal: Marine Ecology Progress Series (Theme Section: Comparative analysis of marine fisheries production)
Authors: Bundy A, Bohaboy EC, Hjermann DO, Mueter FJ, Fu C, **Link JS** (NOAA/NMFS/NEFSC)
Expected publication date: June/July 2012

Summary: Marine ecosystems are dynamic, often have open boundaries, and their overall productivity responds nonlinearly to multiple drivers acting at multiple temporal and spatial scales, under a triad of influences: climatic, anthropogenic and ecological. Using a comparative approach, the authors apply a system-level surplus production modeling approach to the total aggregated catch and biomass of all major targeted fish species in twelve exploited Northern Hemisphere ecosystems, comparing two variations of a surplus production model: a regression model and a dynamic model that were each fit with and without environmental and biological covariates. This work demonstrates the feasibility and value of estimating fisheries production for an *entire* ecosystem.

Important conclusions: Results from this study support the importance of an ecosystem approach to fisheries management and suggest the following key points:

- The relationship between fisheries yield and primary production is not as simple as suggested in other studies.
- Environmental factors, particularly water temperature, affect productivity.
- Emergent properties of Northern Hemisphere systems suggest that *MSY* values and optimal exploitation rates are relatively consistent: *MSY* ranges between 1 and 5 t km-2 and optimal exploitation rate between 0.1 and 0.4 yr-1.

2b. **Title: Comparative analysis of cod and herring production dynamics across thirteen northern marine ecosystems**
Journal: Marine Ecology Progress Series (Theme Section: Comparative analysis of marine fisheries production)
Expected publication date: June/July 2012
Authors: Holsman KK, Essington T, **Miller TJ**, Koen-Alonso M, **Stockhausen WJ** (NOAA/NMFS/NEFSC and AKFSC)

Summary: We conducted a comparative ecosystem analysis to understand environmental and biological drivers of production dynamics of two common species groups, cod and herring across thirteen large marine ecosystems. Across ecosystems, models including biophysical covariates exhibited stronger fits to the data and were often included in the top set of selected models. However, the numerical impacts of covariates differed among

systems and species. For example, surplus production in several ecosystems was significantly affected by sea surface temperature, but to differing degrees (i.e., direction and magnitude of effect). Similarly, surplus production of cod was positively associated with herring biomass in four of the ecosystems examined, whereas negative trophodynamic interactions alluded to complex cultivation/depensation food-web dynamics in five other systems. Importantly, no single covariate emerged as the most important predictor of surplus production nor were biological reference points from models with covariates always more conservative than those without covariates. This suggests that inclusion of trophodynamic and biophysical covariates in simple production models has the potential to increase model fit, but the relative benefit will be stronger for systems and species where trophodynamic and biophysical processes are tightly coupled to species productivity.
Significance: Model fits for two common types of fish species were improved by including environmental covariates, including thermal and trophodynamic features. The relative benefit will be stronger for systems and species where trophodynamic and biophysical processes are tightly coupled to species productivity.

2c. Title: Aggregate surplus production models for demersal fishery resources of the Gulf of Maine
Journal: Marine Ecology Progress Series (Theme Section: Comparative analysis of marine fisheries production)
Authors: Fogarty MJ, Overholtz WJ (ret.), Link JS (NOAA/NMFS/NEFSC)
Expected Publication Date: June/July 2012

Summary: We developed surplus production models for 12 demersal fish species in the Gulf of Maine at the single-species and aggregate-species levels. Summed single-species production model reference points were higher than estimates from the aggregate surplus production model. The equilibrium yield (MSY) and BMSY levels for the summed single-species production model reference points exceeded the aggregate model results by 28.0% and 27.5% respectively. Biological interactions such as predation and competition are potential reasons for differences between the aggregate and summed results. Not accounting for biological interactions may result in overly optimistic predictions of long-term sustainable yield and unrealistically high estimates of biomass at MSY. We find high concordance between single species production model reference points and results from a range of other estimation methods employed in assessment of these species, suggesting that the results from the aggregate production model analyses are not artifacts related to model type. Tests for the effect of environmental variables, including the Atlantic Multidecadal Oscillation index, the winter North Atlantic Oscillation index and the Extended Reconstructed Sea Surface Temperature series suggested possible effects of the NAO at a lag of zero and the ERSST at a lag of 2 yr based on cross-correlation analyses. However, further tests proved inconclusive when the covariates were introduced into an extended surplus production model. Given the potential shifts in productivity that can accompany climate change, this issue should be periodically re-evaluated and where appropriate, a more dynamic approach to setting reference points pursued.

2d. Title: Synthesizing lessons learned from comparing fisheries production in 13 northern hemisphere ecosystems: emergent fundamental features
Journal: Marine Ecology Progress Series (Theme Section: Comparative analysis of marine fisheries production)

Authors: Link JS, Gaichas S, Miller TJ, Essington T, Bundy A, Boldt J, Drinkwater KF, Moksness E (NOAA/NMFS/NEFSC)
Expected publication date: June/July 2012
Summary: Understanding the drivers that dictate the productivity of marine ecosystems continues to be a globally important issue. A vast literature identifies three main processes that regulate the production dynamics of fisheries: biophysical, exploitative, and trophodynamic. Here we synthesize results from international workshops where surplus production models were applied to 13 northern hemisphere ecosystems that support notable fisheries. Results are compared across systems, levels of species aggregation, and drivers. By applying surplus production models at single-species (SS), multi-species (MS), aggregated group, and full-system levels across ecosystems, we find that the different levels of aggregation provided distinct, but complimentary, information. Further, it is clear that all three drivers contribute to fisheries productivity in each ecosystem, but we find that key drivers are system-specific. Our results also confirm that full-system yield is less than the sum of SS yields and that some MS and aggregate yields may lead to overharvest of some stocks if species groups are constructed without considering common productivity, inter-species and environmental interactions.

Important conclusions: Several fundamental features emerge from this work that can improve how we manage fisheries:

- Biomass accumulation tends to be sigmoidal.
- Modeled productivity of fisheries is improved by inclusion of environmental and ecological variables.
- Full system yield is less than the sum of single-species or multi-species yield.
- A rule of thumb for harvesting should be a 1-5 t km-2.

Regional/Highly Specialized Journals

2e. Title: Harmful algal blooms along the North American West Coast Region: history, trends, causes, and impacts
Journal: Harmful Algae
Authors: Alan J. Lewitus (NOAA/NOS/NCCOS/CSCOR), Rita A. Horner (UW), David A. Caron (University of Southern California), Ernesto Garcia-Mendoza (Centro de Investigación Científica y de Educación Superior de Ensenada, Mexico), Barbara M. Hickey (UW), Matthew Hunter (Oregon DFW), Daniel D. Huppert (UW), Deirdre Kelly (Canadian Food Inspection Agency), Raphael M. Kudela (UCSC), Gregg W. Langlois (California DPH), John L. Largier (UC Davis), Evelyn J. Lessard (UW), Raymond RaLonde (University of Alaska), J.E. Jack Rensel (Rensel Associates Aquatic Sciences), Peter G. Strutton (OSU), **Vera L. Trainer (NOAA/NMFS/Northwest Fisheries Science Center),** Jacqueline F. Tweddle (OSU)
Publication Date: August, 2012

Summary: Along the Pacific coast of North America, from Alaska to Mexico, harmful algal blooms (HABs) have caused losses to natural resources and coastal economies, and human sicknesses and deaths for decades. Recent reports indicate a possible increase in their prevalence and impacts of these events on living resources over the last 10-15 years. Two types of HABs pose the most significant threat to coastal ecosystems in this "west coast"

region: dinoflagellates of the genera Alexandrium, Gymnodinium, and Pyrodinium that cause paralytic shellfish poisoning (PSP) and diatoms of the genus Pseudo-nitzschia that produce domoic acid (DA), the cause of amnesic food poisoning (ASP) in humans. These species extend throughout the region, while problems from other HABs (e.g., fish kills linked to raphidophytes or Cochlodinium, macroalgal blooms related to invasive species, sea bird deaths caused by surfactant-like proteins produced by Akashiwo sanguinea, hepatotoxins from Microcystis, diarrhetic shellfish poisoning from Dinophysis, and dinoflagellate-produced yessotoxins) are less prevalent but potentially expanding. This paper presents the state-of-knowledge on HABs along the west coast as a step toward meeting the need for integration of HAB outreach, research, and management efforts**.**

2f. **Title: A multi-beach study of Staphylococcus aureus, MRSA, and enterococci in seawater and beach sand**
Journal: Water Research
Authors (*NOAA authors in* ***bold***) and affiliations (*Line Office and Program or Lab*):
Kelly D. Goodwin, Melody McNay, Yiping Cao, Darcy Ebentier, Melissa Madison, John F. Griffith.
Expected publication date: available on-line now. In print: most likely sometime in July.
http://dx.doi.org/10.1016/j.watres.2012.04.001
Summary: The paper describes detection of the bacterial pathogen *Staphylococcus aureus*, including antibiotic resistant strains (MRSA), in seawater and beach sand. *S. aureus* concentrations in seawater were strongly correlated to *S. aureus* concentrations in sand. Other explanatory variables included water temperature, the concentration of enterococci in seawater, and the number of swimmers.

Important conclusions: The frequent detection of *S. aureus* (>50%) in seawater and beach sand samples and the correlation with water temperature supports the concern that bacterial pathogens exist and may persist in the environment, including at beaches.
The data indicate the potential for virulent and antibiotic resistant strains to be encountered in this environment. To provide context for the results, the prevalence of *S. aureus* in sand was compared to published fomite studies, and results suggested that beach prevalence was similar to that in homes.

Ultimately, the significance of these findings in the environment depends on the infectious dose. The concentrations reported here are lower than the dose thought able to infect intact skin. However, the infectious dose of *S. aureus* is substantially reduced by factors such as foreign bodies or synergy with other contaminating microbes. Both of these modifying conditions could be expected in beach settings, particularly for contamination of a wound with sand. Therefore, obtaining a more accurate assessment of infectious dose under a variety of real-world conditions is an important area for future research. In any case, based on previous human studies, rinsing and drying the skin should help provide protection, particularly for intact skin.

3. OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

3a. **Title: Examining the conservation value of marine management areas within the Monterey Bay National Marine Sanctuary: how protected is the sanctuary?**

Journal: Office of National Marine Sanctuaries Conservation Series
Authors: Jason Adelaars, Nicholas Donlou, Megan Kelly, Corina Marks, Beth Pardieck, James Lindholm
Publication Date: June 30, 2012

Summary: A growing number of marine management areas in state and federal waters leads to the assumption that adequate protection exists in our oceans. However, the need to assess the relative contribution of these management areas to overall resource conservation has been made apparent by previous studies. For this study, we created a scoring system based on prohibited uses, size, and permanence of management areas to assess the level of conservation within the Monterey Bay National Marine Sanctuary (the Sanctuary). Additionally, we examined the effect of overlapping management areas, explicit use areas, and the proximity of ports on overall conservation value. We found that despite abundant management areas the relative conservation within the Sanctuary is low. Furthermore, there is also a noticeable difference in conservation between state and federal waters, with state waters generally having higher conservation. To increase conservation in the federal waters of the Sanctuary, collaboration between the Office of National Marine Sanctuaries and National Marine Fisheries Service is necessary. Comprehensive protection from the negative effects of human uses, such as oil and gas mining, and commercial and recreational fishing would dramatically increase the conservation of federal waters within the Sanctuary, even if these areas are relatively small.

3b. Title: Bern Megrey: pioneer of comparative marine ecosystem analyses
Journal: Marine Ecology Progress Series (Theme Section: Comparative analysis of marine fisheries production)
Authors: Moksness E**, Link J,** Drinkwater K**, Gaichas S (**NOAA/NMFS/NEFSC)
Publication Date: June/July 2012

Summary: This special issue is dedicated to Dr. Bernard Megrey. Dr. Megrey's scientific work certainly was much broader than just comparative studies, and defining his career is difficult given the breadth and impact of his work. Yet in the context of the current theme section, we specifically note that Dr. Megrey was a pioneer in comparative marine ecosystem studies, executing them well before they became as high profile as they currently are. Always a big fan of larger, international group projects, he was strongly involved in studies comparing marine ecosystems of many northern hemisphere countries. In these contexts he championed the use of simple but robust models to compare ecosystems. He particularly helped to organize an international effort on stock production modeling involving a trilateral of the US, Canada and Norway, a notably productive and successful comparative workshop.

A follow-up workshop was again held in Woods Hole in 2011, the Surplus Production Modeling Workshop, as expanded to include additional countries and their associated marine ecosystems as well as a broader range of modeling approaches. The resultant manuscripts from that workshop are presented in this special theme session. Dr. Megrey was excellent at bringing together people from disparate backgrounds; such that it is highly unlikely that the degree of cohesiveness among scientists from so many different perspectives would have been as strong as it was, thus facilitating such productive workshops and international collaborations.